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by Barbara Flueckiger

In his landmark study *The Virtual Life of Film*, David N. Rodowick rephrases André Bazin's famous question 'what is cinema?' using the past tense: 'what was cinema?' He notes that, paradoxically, film studies is dealing with an object that no longer exists; it ceased existing as an object of study in the 1970s when 'cinema' as 'the projection of a photographically recorded filmstrip in a theatrical setting'[1] was replaced by various other means of presentation, such as video cassettes and later video discs.

Since the publication of Rodowick's study in 2007 the situation has changed considerably. Now, in 2012, we have complete digital projection in movie theaters on a global scale. An overwhelming majority of films are no longer shot on photo-chemical stock. Even Martin Scorsese, who has long been an advocate of analog films, has turned to digital capture for his recent movie *Hugo* (2011), and he has just admitted that he will abandon analog filmmaking in his future projects.[2]

On 19 January 2012, Eastman Kodak filed for bankruptcy after 131 years in the business of photo-chemical stock fabrication.[3] Also, all the manufacturers of mechanical cameras have ceased production. ARRI, one of the most well-established companies, has mastered the conversion to all-digital cameras most convincingly by producing the ALEXA, which combines the classical features of analog cameras with advanced features in the digital domain.

Turning back to Rodowick's notion, we should state that the so-called digital revolution has long been foreshadowed by its electronic predecessors. We should also admit that only within certain limits has there ever been such a thing as ideal conditions for the consumption of movies as they were conceived by their creators. Even in earlier times there were small-gauge prints for home projection, as well as other alternative modes of presentation in schools and film clubs and other such non-professional exhibition venues.

While the discipline of media studies has discussed the digitisation of media in an enormous amount

of publications and within a broad conceptual framework, very few of those publications have shed light on the consequences of this media transition on our perception of the filmic past. It is mostly within an archival discourse that the digitisation of historical films has received some attention. In her book *From Grain to Pixel: The Archival Life of Film in Transition*, Giovanna Fossati identifies a lack of exchange between archives and academic institutions. As such, she establishes some very useful frameworks to investigate the topic by combining archival practices with a film studies perspective.

In this essay I will investigate an even more neglected topic: the transformation of historical films as tangible objects by the process of digitisation. My observations are based on my earlier written reflections on the material properties of digital images,[4] on topics related to the ethics of (film) restoration, and on my recent research on historical film colors[5] in the framework of the project 'Film History Re-mastered'[6] with Franziska Heller, where we focus on the aesthetic and discursive consequences of the digitisation of archival films.

Death of the cinema

Even before Rodowick, Paolo Cherchi Usai announced 'the death of the cinema in the "digital dark age".' Cherchi Usai's famous and deeply inspirational text is saturated with sharp notions on the ephemeral quality of films: 'for cinema is the art of destroying moving images'.[7] As soon as a film is presented in the exhibition hall it starts to wear down with scratches and tears, curling, and color fading, not to mention the human intervention by directors, producers, and distributors who often alter the film in destructive ways if it is deemed to be mandated by external forces (such as audience reactions).

Cherchi Usai clarifies the meaning of a 'model image', which is the film as it was initially conceived and which offers the viewers a 'complete experience of the narrative and the pictorial character of the moving image'.[8] This is dependent on a 'perfectly designed environment in which the moving image is to be seen'[9] in combination with several formalised factors that enable a pleasurable filmic experience.

However, decay and the tangible evidence of a film's use are, as Cherchi Usai points out, at the very foundation of a film's history. The perfect image lacks a history. Thus, restoration and preservation derive 'from motivations that are at best alien, if not contrary, to the unstable nature of the carrier. The main aim of each project of moving image preservation is therefore, *strictu sensu*, an impossible attempt to stabilise a thing that is inherently subject to endless mutation and irreversible destruction. A vain effort it is, but also one that is fertile in its implications. Preservation of the moving image is a necessary mistake.'[10] Or, in other words, any attempt to restore a film is not only a fight against its death, but also a significant intervention into its being as a historical object.

With digitisation these interventions reach a new level, albeit one that is conceptually tied to earlier forms, as Fossati rightly observes in her discussion of simulation in film restoration.[11] One case in point is the so-called 'Desmet process', where tinting is simulated by the exposure of color film stock to uniform light;[12] others include double-exposures on the optical printer to complete missing parts in singular frames. Any such intervention by a restorer not only averts the process of decay but also erases a film's history and endangers its authenticity as a record of the past.

Film as a material object vs. film as performance

To discuss this issue in detail we will need to investigate film's essence as an object. What is film? What distinguishes it from other moving pictures (for example, analog and digital video)? Film as a material object is located at the intersection between a recording process and its projection in the movie theater or on any other display. To put it differently, film as an object is the result of a certain

recording process in combination with subsequent development, editing, optical works, color grading, and printing. These processes are optimised from the outset to deliver film as a basis for projection, whereby the film is set in motion intermittently and light is cast through the individual frames on a reflecting screen.

Much has been written about this mechanical basis, most famously by Bazin, who drew some essentialist notions from film's mechanical workings to explicate its cultural value as a record of reality. Walter Benjamin's materialist arguments about the loss of aura in the age of reproduction developed a different account of the cultural value of film based on its mechanical working. William J.T. Mitchell[13] cites John Berger to demonstrate the often pejorative cultural value that is attributed to photographic records due to their adherence to a referent by means of its mechanical apparatus: '[p]hotographs, as he [John Berger] defines them, are quite simply "records of things seen…no closer to works of art than cardiograms".' Thus, the material basis sets in motion vast philosophical and cultural consequences on the essence of film and its state in our society.

In fact, most film viewers are almost completely unaware of these material foundations. This is particularly true nowadays, when many consumers no longer even shoot analog photographs. Hence, their experience of film is completely detached from film's material basis. In the act of film consumption we do not perceive the film as a material but rather as performance – independent of what support it was shot on or what process it went through in post-production. What we see in the movie theater is light filtered through the film and reflected from the screen. What we see when we consume film on an electronic device is light emanating from either cathode ray tubes, LEDs, or LCDs. Thus, the material experience of film is neither celluloid nor its electronic variants such as magnetic tapes or circuits, but rather the flow of light that reaches our eyes.

To discuss a similar topic Rodowick turns to Noël Carroll's anti-essentialist arguments on the medium-specificity of film in depth. Carroll's main point is to abandon the term 'film' altogether and to replace it with 'moving images'. In this terminological shift, moving images are conceived independent of the carrier or their medium in the strictest sense. From this perspective, analog photo-chemical film is no more than an interlude within a broader history of moving images. Rodowick raises two objections against the medium-specificity in Carroll's argument: 'that a medium directs its uses, and consequently that the evolution of art practiced in a given medium is directed by a telos'.[14] Both of these objections question normative and essentialist arguments; that is, arguments used by such famous theoreticians as Siegfried Kracauer and Bazin that date back to fundamental philosophical notions, such as those presented by Gotthold Ephraim Lessing in his book *Laokoon oder über die Grenzen der Malerei und Poesie*. In Carroll's view, as Rodowick elaborates,[15] any instantiation, i.e., any token or template of, for example, Fritz Lang's *M Eine Stadt sucht einen Mörder* (1931) is the same type of moving image, regardless of whether the template is a DVD, a video cassette, or a photo-chemical print.

In addition to the historical objection to this view, the aesthetic dimension that is connected directly to the material is largely absent from Carroll's analysis. In his perspective, a work's identity is only defined by a conceptual gestalt, similar to a melody which we can identify independently from its actual representation, be it sung or played by an orchestra, recorded on a CD, or streamed online. This is a purely idealist concept of film, one that Fossati labeled conceptual artifact as opposed to the material artifact.[16] The divide between the conceptual work of art and its material body is of great concern to the larger discussion here.

In fact, we should observe that even within the discipline of film studies there is not enough care as to what material object is analysed – even more so, neither the DVDs nor many of the films in archives have a documented history of their origins. Most often, we are confronted with a careless presentation of any available template of a film, and film historians do not even shy away from

showing YouTube videos on a quality scale that has no lower limits (as my colleague Mariann Lewinski noted in a recent talk). To summarise these observations, we should make a distinction between the film as a text (i.e., as a conceptual object), the film as a token (i.e., as material object), and the film as a performative instance in projection.

While digitisation in accordance with Carroll's observation does not affect film as a text, it transforms the film as a material object and as a performative instance – not only on the level of its physical composition, but also in the sensory domain that affects the aesthetic dimension. Each of these modes of being, or ontologies, has a different history. This also holds true for each print, and it contradicts Benjamin's diagnosis of the loss of aura in the age of mechanical reproduction.

To get back to Cherchi Usai's and Rodowick's thoughts about the death of cinema, it is precisely this historical situation of transition and loss that enables the current change in appreciation. Suddenly there is a rising awareness for vintage prints, though only hesitantly, and limited to well-known films which are regarded as masterpieces, such as *The Red Shoes* (Michael Powell and Emeric Pressburger, 1948), *Il Gattopardo* (Luchino Visconti, 1963), *Taxi Driver* (Scorsese, 1976), or *Metropolis* (Lang, 1927). It may seem a paradox that the awareness of vintage prints is caused by their digitization, digital projection, and distribution at A-list festivals such as Berlin and Cannes.

The film's body

As a material object film consists of several layers, each of which is the product of a specified process. When we consider the least complex case, e.g. black-and-white film, it is composed of a carrier (cellulose nitrate, di-acetate, or polyester) in combination with an emulsion that contains the silver grains. These grains are distributed randomly in the emulsion and their size varies with the sensitivity of a specific film to light. As many theoreticians have pointed out (most notably, again, Bazin), it is the light emanation of the physical world which materialises as a direct imprint. This is similar, he notes, to the shroud of Turin that captured the image of Christ.

As a material object film is the product of several histories, the first of which is the history of its production. This history is grounded in psycho-physical insights into human vision, such as the phi phenomenon that enables the fusion of a series of still images into the perception of a continuous movement. Furthermore, the grey scale distribution (the S-shaped gradation of a film) roughly matches the perception of luminance in reality and is at the very foundation of film's potential to depict a scene.

Another decisive factor is the spatial resolution, whereby the individual elements (the silver grains) recede behind the global impression of film as a representation of something and not as a surface consisting of transparent and dark spots. In other words, a number of constraints regulate the properties of a filmic material in such a way that it is able to elicit a pictorial perception. Within these constraints a great variety of film materials have emerged – in different sizes, with different sprocket holes, and with different frame characteristics that define the division between image components and other elements of the film (such as the perforation area or the line between subsequent frames).

A certain standardisation of formats emerged in the 1920s, despite an earlier conference on the subject held in Paris in 1908.[17] Manufacturers often added specific codes to the non-image areas which designate the origin, the time, and the properties of a certain film strip.[18] These edge marks contain alpha-numeric information about the film's production history or the distributor. Independent of the depicted content, this information serves as meta-data which is very important in order to contextualise the historical origin and identification of a film.[19]

Fig. 1: Edge numbers on an original print of Written on the Wind (Harvard Film Archive, Technicolor dye transfer print 1956, item no. 3663, photography by Barbara Flueckiger).

A second history of a filmic object is the result of its processing. Again, these processing steps are defined by constraints that serve the same purpose as in production – to produce a legible depiction of the world and at the same time, to optimise the product according to certain standards and professional requirements. Contrast between the lightest and the darkest image portions, grey scale, and the amount of grain are greatly influenced by the development process, the chemicals applied, the length of treatment, and the temperature of the individual steps. It is only in the so-called 'reversal process' that we see the original image as it was exposed in the camera. The majority of treatment methods are negative-positive processes, where a printing step mediates between an original and its copy. Such a step introduces a gap in the history of a film and thus a severe detachment from the authentic material as it was captured at the site of the event depicted.

Almost every aspect of a film is open to transformation at this step, including heavier interventions such as optical printing with double-exposure, traveling mattes, in-painting, and so forth. Regarding the meta-data, it is questionable whether this information is introduced in the printing process, whether it is eliminated completely, or whether it is over-written or altered in the process. Gauge type and aspect ratio can be changed – and even the omission of image parts is quite common in this step.

When a film is shot with several cameras (which was standard practice in silent and early sound films), there are several negatives depicting identical scenes. Picture prints are combined with a variety of sound prints or magnetic tracks. Working prints were often inscribed with hand-written or stamped numbers to sustain the book-keeping in the editing process. One of the most severe consequences of the printing practice on our perception of film history is the almost complete loss of early color prints on nitrate due to their being copied on safety stock.

Once the print is subjected to projection it acquires a third history by the marks of its use (aforementioned with reference to Cherchi Usai), such as dirt and scratches, punch holes for the indication of reel change, slices, cracks, and written annotations. Moreover, film decays due to inherent chemical and physical processes that occur in relation to environmental conditions such as exposure to heat, humidity, light, chemical agents, or micro-organisms. It shrinks, it becomes brittle, it curls, it breaks apart, it is affected by bacteria and fungi.

Most often, these histories collapse into an individual film object, even when we consider anything else than the original camera negative. These histories have overlapping traces; they interfere with and mask each other. When we acquire such a filmic object at a certain time, a broad knowledge is necessary to identify the different strands of influences present in it. Beyond mere visual inspection, the film's material body is very tangible to all the senses. It accumulates olfactory, haptic, and even acoustic dimensions, each of which form part of this singular element's authenticity. The element has a certain thickness; it has a certain stiffness/elasticity and stability. Its surface has individual or typical reflection properties. The emulsion can form a relief or show other small-scale textures. Its smell indicates not only the material basis but also the healthiness of that material. Decaying nitrate is said to smell like wet dog fur. Vinegar syndrome is identified by the corresponding smell.

When furled on a bobby, the support's color becomes more obvious. It may be yellowish, opaque, or transparent. Several color processes add to the huge variety of tangible properties. Line screen processes such as Spicer-Dufay and Dufaycolor show lines filled with dye in combination with silver grains. Lenticular screen processes such as Agfacolor Linsenrasterfilm or Kodacolor (Keller-Dorian), Thomson or Berthon-Siemens, have parallel lenses embossed on their surface. These small lenses diffract the light rays stemming from striped color filters both in front of the camera and the projection light. Many two-color processes were printed on so-called duplitised stock, where each side of the print was covered with an emulsion. Technicolor process no. 2 consisted of two very thin film-strips cemented together. For the German/Dutch Sirius system, both sides of the film were mordant-toned and show variations on thickness and reflection properties (see image). This list is by no means exhaustive. It is only an indication of how many different sensorial traces can be incorporated in a film object.

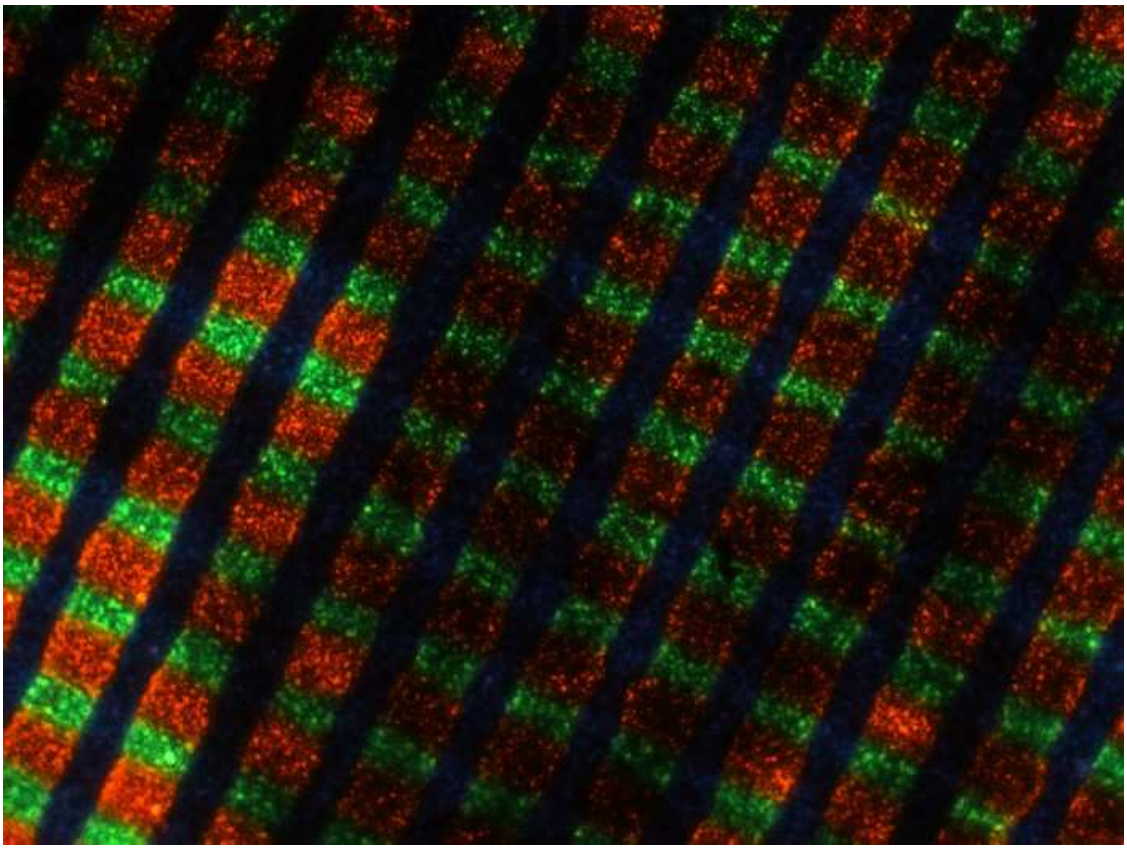

Fig. 2: Spicer-Dufay (ca. 1930), magnification 20x (photomicrograph by Silvana Konermann).

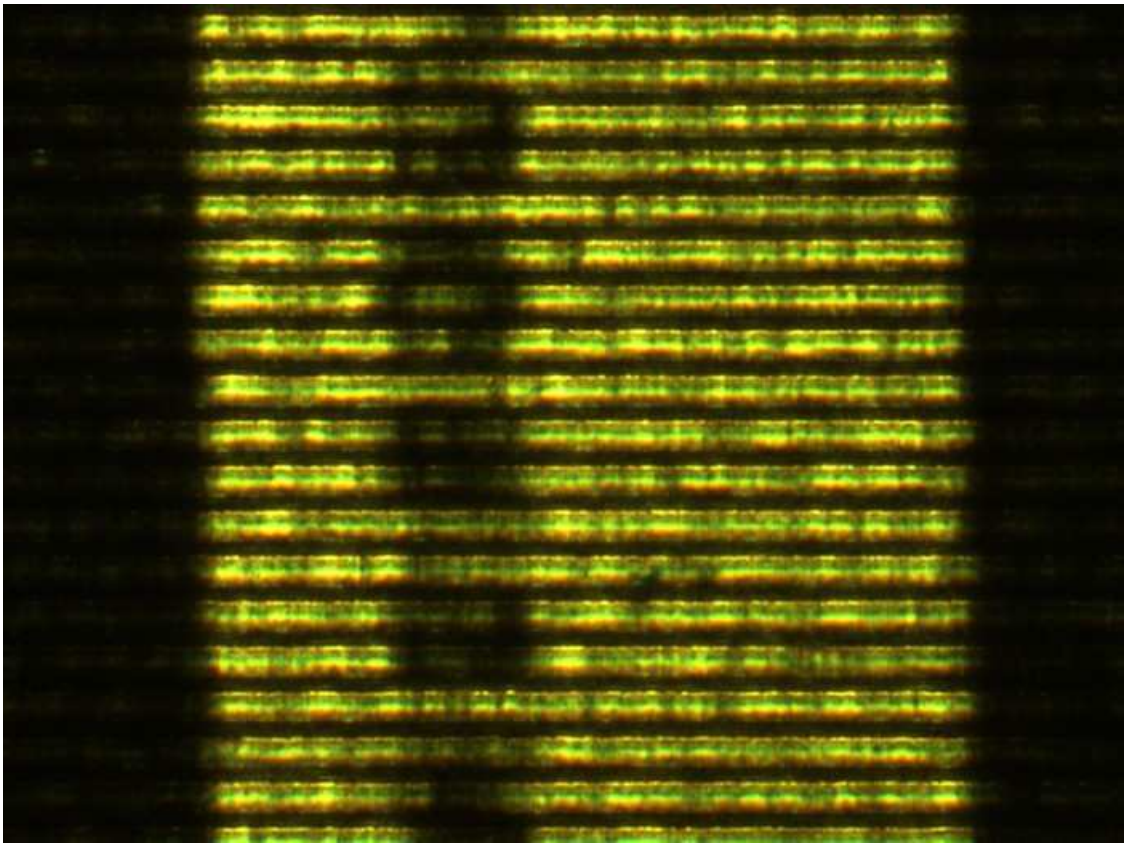

Fig. 3: Light diffracted by Agfacolor lenticular film (ca. 1930), magnification 20x (photomicrograph by Silvana Konermann).

Fig. 4: Reflection on Sirius Kleurenfilm, front (photography by Barbara Flueckiger).

Fig. 5: Reflection on Sirius Kleurenfilm, back (photography by Barbara Flueckiger).

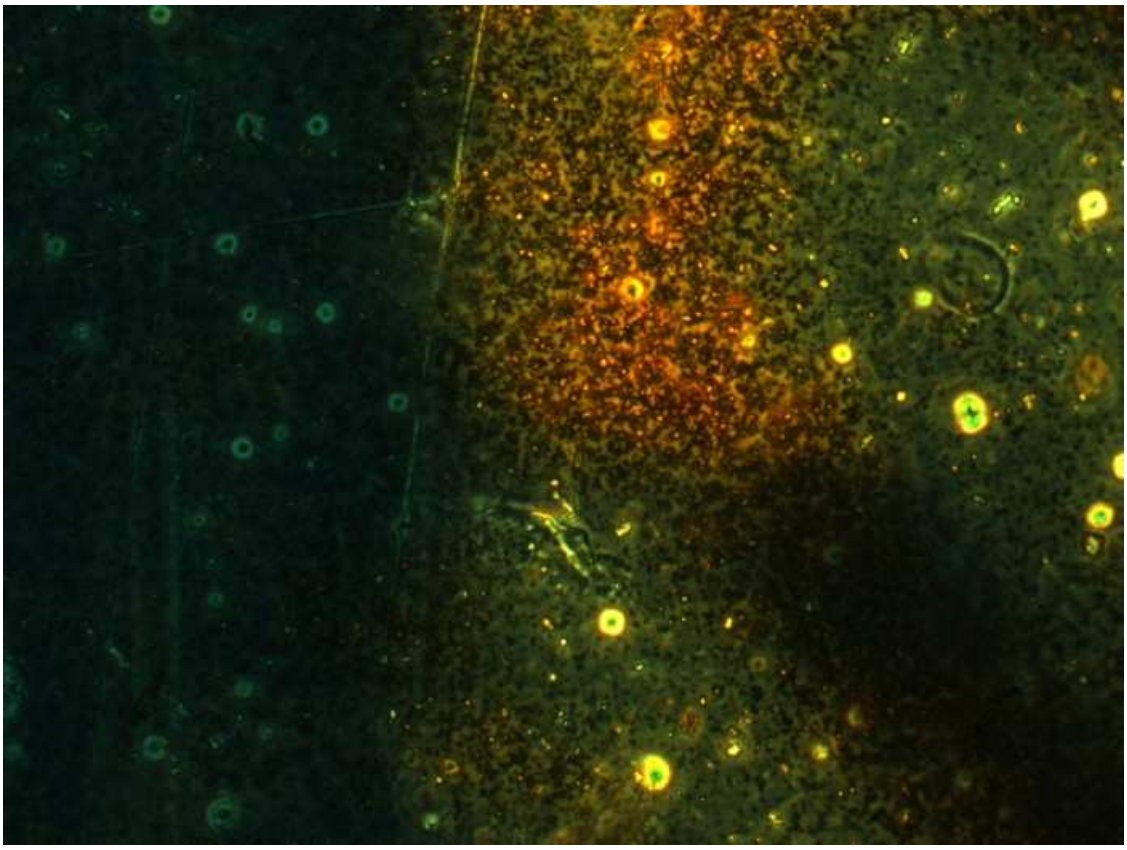

Fig. 6: Sirius Kleurenfilm, magnification 20x (photomicrograph by Silvana Konermann).

Materiality and opacity of digital data

As mentioned before, though printing a film produces a gap in the history of its material, this gap is much more pronounced in the case of digitisation. Digitisation (the scanning of film) means the transformation of a physical object into digital data. Many theoreticians who have reflected on digitisation stated that digital data is devoid of any material basis. In my investigation of properties of digital images I have elaborated a different account, which forms the basis of the following discussion.[20]

One of the most important insights I elaborated is the fact that there is no such thing as *the* digital image, only a variety thereof. There is a big difference whether a digital image is captured with a digital camera or whether it was generated by means of computer software. In addition, there are processes that translate analog images into the digital domain, either to render them with software for compositing, along with other post-production tools such as editing or color grading, and/or to display them on electronic devices. For many years a majority of films have been shot on analog stock, then scanned, post-processed, and ultimately printed back on film for distribution in the cinema.

Despite the great variety of digital images all of them share some common features. With the exception of procedural forms of representation which are independent of resolution, all digital images are raster graphics represented by an orthogonal grid of pixels. Each pixel is assigned a value, and this value is encoded in binary form through a combination of the digits 0 and 1. The range of these values is explicitly defined by the bit-depth. An 8-bit representation consists of 2^8 which equals 256 steps; a 10-bit representation of 2^{10} equals 1024 steps. All the steps between the minimum and the maximum are assigned integer multiples of a basic value.

Therefore, a digital representation is said to be discrete because it consists of separate tonal values, in

opposition to analog representations with continuous tones. In his now famous statement, Mitchell suggested the following metaphor to illustrate the fact: '[r]olling down a ramp is a continuous motion, but walking down stairs is a sequence of discrete steps – so you can count the number of steps, but not the number of levels in a ramp.'[21] As I have previously elaborated,[22] this metaphor has become obsolete when we consider human perception as a reference. Or, in other words: are there still steps if we perceive them as ramps?

The bit-depth and the spatial resolution of advanced digital images can greatly surpass the resolution of 35mm film. Pixel size is well below the size of individual grains. We should even ask ourselves if a photographic image with a structure of white (no grain) and black (grain) should not also be considered as a discrete representation in a 2-bit encoding. Every shade of grey in this system is a function of the accumulation of silver grains in the emulsion. While this observation is not devoid of truth, in the case of photo-chemical stock we need to consider the third dimension which enables individual grains to be located in variable depth throughout the emulsion.

In order to transform an analog image into a digital one by scanning, the image is mapped onto a grid in the digital camera represented by the array of sensors on the CCD or CMOS chip. Therefore, scanning is a simple process of photographing; it is analog in the first step, meaning that there is a proportional connection between incident light and the electric charge generated in the sensor. Only afterwards are these values mapped on a discrete scale by quantisation and then assigned binary values by encoding the voltage into mathematical data. Each digitisation thus requires a combination of selection in the sampling process and then analysis which defines an explicit protocol regarding how these individual samples are mapped onto the discrete range of binary encoding.

The transformation of physical properties into binary values is crucial for the topic discussed here. While the physical dimensions are accessible to our perception (albeit only in specific dimensions, and not down to the molecular level), these tangible properties are lost in the process. Digitisation is a process of abstraction; sensory impressions are mapped onto a mathematical description of this data. Mark J.P. Wolf has analysed the cultural aspects of this transition. He proposes that there has been a long history of quantisation in cultural practices, such as monetary currencies, where tangible goods were transformed into symbolic means of value exchange.

In fact, there are many domains in our experience and perception where we have established quantisation systems, for example in the perception of time. Nelson Goodman[23] has argued that we can only deal with complex phenomena by breaking them down into classification systems which order them in a prescribed manner. In her famous study on the classification of colors, Eleanor Rosch was able to prove that categorisation systems are in operation even independently of language when humans are confronted with continuous phenomena. This serves the reduction of complexity as well as the inter-subjective exchange of communicational entities.

As mentioned in the introduction to this section, many theoreticians have drawn the conclusion that digital data is devoid of any materiality. I would rather suggest that the materiality of digital data is of a different order. In photo-chemical images the information manifests itself immediately in the filmic object and it remains accessible to the senses. In contrast to this immediate and tangible form of materiality, digital data vanishes behind an opaque surface; it is stored in containers such as hard drives or solid-state drives, on LTO tapes or DVDs. It is even possible to engrave the binary code in stone or to record it as a barcode on film.[24] Thus, the connection between digital data and its containers is arbitrary, or, as I have stated, the materiality of digital data is polymorphic.[25]

Severing the film's imago from its carrier

In his theory of restoration (*Teoria del restauro*), Cesare Brandi distinguishes between the imago and

its carrier, the imago being the image as it presents itself to our senses. While imago and carrier are intimately connected in the analog world, as I have shown, there is a complete separation of the two in the digital domain. Even the most sophisticated digitisation of a historical film does not capture the very materiality and tangibility of the film as an object. Thus, we lose crucial aspects of the film's authenticity (its haptic and olfactory properties, and even some visual dimensions, such as reflection), even when we have access to the best elements, such as a première version of a film.

Fig. 7: The film as object (the Pathé Baby film Le Népenthès, une plante qui capture les insects, EYE Film Institute Amsterdam, photography by Barbara Flueckiger).

Fig. 8: The film as object, macro (the Pathé Baby film Le Népenthès, une plante qui

capture les insects, EYE Film Institute Amsterdam, photography by Barbara Flueckiger).

By disconnecting the imago from its carrier, we suppress many dimensions that were present in the filmic object. The film's three-dimensional quality, its surface structure, its reflection and light scattering properties, and its chemical composition are all lost in the process. Even more so, most digitisation processes capture only those image components present on the film strip, leaving out the sprocket holes, the frame line, and most importantly, the information present on the film's edge. For instance, tinted films are often scanned in black-and-white because of their uneven colorisation due to the decay of the dyes. There are many issues with the digitisation of historical color processes that have been completely unresolved to this date.

In the digitisation of paintings we can observe a growing awareness of these factors. There are several approaches to solve these problems. One is to capture these objects on a light stage or on similar camera arrays. The light stage was developed by Paul Debevec and his team to capture objects from all angles by the use of a high number of cameras distributed on a spherical rig. These cameras take pictures under a variety of standardised illumination settings, thus allowing them to not only gain detailed information about an object's shape but also about its reactions to incident light. A painting or a sculpture can be recorded including all these factors, such as small-scale geometric variations caused by the canvas and the paint applied, as well as translucency and reflection of the paints from every possible viewing angle.

Another approach to record the material object is confocal microscopy, whereby a depth-sensitive microscope records subsequent layers. These layers are consequently combined by computer software into three-dimensional depictions of the object. In art restoration, many such scientific approaches are in operation. One of the most important steps in restoration is the encompassing documentation of the object in its initial stage.

The performative aspect of film in projection does not require that all of this information be recorded, since we do not perceive everything in the cinema. However, while every presentation of a film is influenced by the properties of a projection system, in a digitised film all these aspects have collapsed into one specific reading as a result of the scanning process and the subsequent post-processing of the digital data. Our experience with different scanners in the two research projects AFRESA and Film History Re-mastered have shown how deeply the scanning is dependent on the properties of the light source(s), the camera properties, and the transport system applied to the film. Restoration ethics would require that all these factors be documented in the process. This requirement is largely absent in most digitisations. Most often we are not even provided any knowledge about the filmic object which was the source of the digitisation process. Even at events such as the festival Il Cinema Ritrovato in Bologna, none of this information is available to the audience on a regular basis. Only rarely do the films' headers contain a summary of the source material and its digitisation.

As early as 1984, Fredric Jameson gave an updated account on the loss of aura in the computer age. In contrary to tangible objects, the computer (and even more so, the casings of digital data) no longer has visual or emblematic power. In a similar fashion, Wolf remarked that the containers of digital data are not part of the art work and therefore cannot share the cult value any longer.[26] The loss of these dimensions is largely due to the detachment of the data from its tangible source. This detachment sets forth an arbitrary, opaque relationship between the data and the objects it describes. They are flattened in so far as they lack any variety. They are mere code, irrespective of the sensory domain the code is meant to address.

In Benjamin's notion of the loss of aura in an age of mechanical reproduction, we encounter a moving ambivalence between nostalgia and a utopian belief in film as the medium which best

expresses the human condition in a modern, urban society. We are now in the middle of a similar turn. Again, we are confronted with a sense of nostalgia that pervades our memory of the tangible filmic past. As art historian Alois Riegl has shown in his study *Der moderne Denkmalkultus. Sein Wesen und seine Entstehung*,[27] there is an immediate sense of loss connected to our appreciation of the beauty of a historic monument which is associated with its marks of decay.

In her reflections on touch in the perception of film and media, Laura Marks describes this impression with an analogy to mourning.[28] She contradicts a notion by Roland Barthes written in *Camera lucida*, in which he describes the mortality of photographs with disdain.[29] In the past 20 years there has been a growing number of artists and filmmakers whose work reflects the effect of decay, for instance the well-known film *Lyrisch nitraat* (1991) by Peter Delpeut, the series Moirés by Eric Rondepierre,[30] or Alexandra Navratil's installation *Sample Frames*[31], with photographs from the Eastman Kodak handbooks *Tinting and Toning of Eastman Positive Motion Picture Film* (1916 ff.), and others.

We have a similar fascination with marks of decay and fading colors in recent application (apps) such as Hipstamatic and Instagram, which flood the web with a multitude of snapshots in the style of old photographs as seen in family albums from the 1960s and 1970s. Yet another strand in contemporary obsession with nostalgia of a medial past can be found in computer-generated imagery, where photographic artifacts – artifacts in the sense of flaws – such as grain, scratches, and dirt serve a variety of functions when embedded into live-action movies.[32]

Jameson has famously argued that in the late capitalism of the postmodern society, the mediated circulation of the past has turned historicity into a commodity which is a deeply ahistorical, 'random cannibalization of all the styles of the past'.[33] Therefore, we can place the pressing topic of the loss of tangibility due to the digitisation of (film) material within a broader cultural context. However, from a theoretical perspective, we should keep a sharp eye on these practices and we should intensify our understanding of how they transform our perception of the cinematic past.

Author

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[1] Rodowick 2007, p. 26.

[2] http://www.independent.co.uk/arts-entertainment/films/news/martin-scorsese-to-abandon-film-to-shoot-movies-digitally-7893449.html (accessed on 4 July 2012)

[3] http://dealbook.nytimes.com/2012/01/19/eastman-kodak-files-for-bankruptcy/ (accessed on 4 July 2012)

[4] Flueckiger 2008.

[5] Timeline of Historical Film Colors: http://zauberklang.ch/colorsys.php

[6] See information on the research database of the University of Zurich: http://www.research-projects.uzh.ch/p15584.htm.

[7] Cherchi Usai 2000, p. 1.

[8] Ibid., p. xii.

[9] Ibid., p. xxiii.

[10] Ibid., p. xxxi.

[11] Fossati 2009, pp. 140 et seq.

[12] Read & Meyer 2000, p. 287; ff. Kross 2006.

[13] Mitchell 1992, p. 26.

[14] Rodowick 2007, p. 35.

[15] Ibid., p. 40.

[16] Fossati 2009, p. 105.

[17] Farinelli & Mazzanti 1994, p. 51.

[18] See for example Kodak's edge codes on http://historicphotoarchive.com/f1/ekcode.html.

[19] Brown 1990, pp. 7 et seq.; Read & Meyer 2000, p. 36 and p. 60.

[20] Flueckiger 2008, pp. 31-50.

[21] Mitchell 1992, p. 4.

[22] Flueckiger 2008, p. 35 f.

[23] Goodman 1978, p. 27.

[24] See Voges & Fröhlich 2012 and the application Bits on Film: http://www.ipm.fraunhofer.de/en/solutions-markets/media_communications/long-term-archiving/bits_on_film.html.

[25] Flueckiger 2008, p. 43.

[26] Wolf 2000, p. 69.

[27] Riegl 1903, p. 9.

[28] Marks 2002, p. 105.

[29] Barthes 1981, p. 93.

[30] http://www.ericrondepierre.com/pages/en_decomp_moires.html

[31] http://www.alexandranavratil.com/projects/Sample-Frames

[32] See Flueckiger 2004, 2008, and 2012.

[33] Jameson 1984, p. 17.

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